

SECTION 34 11 23
SPECIAL TRACKWORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Special trackwork materials.
- B. Fit of switch points.
- C. Shop assembly.
- D. Special trackwork assembly.
- E. Switch machines.
- F. Lubrication.

1.02 RELATED REQUIREMENTS

- A. Refer to Section 34 05 17, Common Work Results for Trackway, for related requirements.

1.03 MEASUREMENT AND PAYMENT

- A. General: Special trackwork will not be measured separately for payment. All costs in connection therewith will be considered as included in the applicable Contract lump sum price or the Contract unit price per linear foot for trackwork of the different types indicated as listed in the bid item in the Bid Schedule of the Bid Form.

1.04 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B18.8.1 Clevis Pins and Cotter Pins (Inch Series)
- B. American Railway and Maintenance of Way Association (AREMA).
 - 1. AREMA Manual.
- C. American Society for Nondestructive Testing (ASNT):
 - 1. ASNT-SNT-TC-1A Recommended Practice, Personnel Qualification and Certification in Nondestructive Testing
- D. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36/A36M Standard Specification for Carbon Structural Steel

2. ASTM A781/A781M Standard Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use
 3. ASTM E10 Standard Test Method for Brinell Hardness of Metallic Materials
 4. ASTM E94 Standard Guide for Radiographic Examination
 5. ASTM E709 Standard Guide for Magnetic Particle Testing
 6. ASTM E164 Standard Practice for Contact Ultrasonic Testing of Weldments
 7. ASTM E165/E165M Standard Practice for Liquid Penetrant Examination for General Industry
- E. American Welding Society (AWS):
1. AWS B2.1/B2.1M Specification for Welding Procedure and Performance Qualification
 2. AWS D1.1/D.1.1M Structural Welding Code - Steel
- F. Society of Automotive Engineers (SAE):
1. SAE J534 Lubrication Fittings

1.05 SUBMITTALS

- A. Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Submit the following for review and approval prior to special trackwork fabrication.
 1. Shop drawings of each special trackwork unit, which detail each component and its proper position in the overall special trackwork layout. Drawings shall include all necessary dimensions, manufacturing tolerances and material descriptions for manufacturing the components as well as a table listing all components shown by name and by part number. Part numbers shall be assigned to components and to finished assemblies. All parts identified by the same part number shall have the same physical dimensions, material composition, performance characteristics and durability.
 2. Field assembly plan for each special trackwork unit showing the turnout location, special trackwork identification code, unique color code and identification number of each component of the special trackwork unit. All components shall be match-marked for that particular special trackwork unit.
 3. Methods used to relieve stress in the frog during fabrication.
 4. Field assembly plans.

5. Welding, hardening and heat treating procedures.
 6. Stress relief methods.
 7. Test program plan.
 8. Turnout work plans for each of the track forms used. Include comprehensive drainage plans and details.
 9. Shop drawings of the derail and wheel crowder for each installation.
 10. Restraining rail design.
 11. Design of vertical safety guard rails.
 12. General trackwork arrangement drawings for all special trackwork.
 13. Certificate of compliance of tie pad (concrete ties).
 14. Special trackwork materials product data, together with the manufacturer's recommended installation procedures for component parts, such as switch rods, rail braces, switch point rollers, auxiliary throwing device assemblies, and switch machines.
- C. Submit the results of each production test specified herein for review and approval to the Engineer prior to shipping special trackwork.
- D. Submit the method of packaging, loading, shipping, and handling the special trackwork and associated hardware for review and approval to the Engineer prior to shipment. For District-furnished materials, submit these in accordance with Section 01 64 13, District-Furnished Materials and Equipment.
- E. Submit inventory records of special trackwork delivered at the time of each delivery. Identify identification and color code, as provided herein, for each unit. For District-furnished materials, submit these in accordance with Section 01 64 13, District-Furnished Materials and Equipment.
- F. Submit test result reports.
- G. Provide additional submittals as required herein.

1.06 QUALITY ASSURANCE AND CONTROL

- A. A qualified independent testing laboratory approved by the Engineer shall perform all special trackwork inspection and testing. The selected laboratory shall employ the proper equipment and qualified testing personnel for the special trackwork testing and inspection described in these Specifications. Special trackwork testing and inspection equipment and personnel shall be subject to approval by the Engineer. The Engineer will, or an independent witness designated by the Engineer shall, monitor the operations at the special trackwork plant to ensure that the inspections

and tests are being performed in accordance with approved procedures and in compliance with these Specifications.

- B. Personnel performing nondestructive testing shall be qualified and certified in accordance with ASNT SNT-TC-1A. Only persons certified for NDT Level I and working under a NDT Level II person or persons certified for NDT Level II may perform nondestructive testing.
- C. Testing equipment shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment calibration shall be certified and traceable to national standards such as the National Institute of Standards and Technology. Testing equipment shall be calibrated in accordance with the requirements of the approved Construction Quality Plan specified in Section 01 45 00, Quality Control.
- D. Test Program Plan
 - 1. A test program plan shall be prepared identifying the approach for accomplishing each of the specified inspections and tests. A narrative shall be prepared for each required test and inspection specified, describing the test set-up; equipment, and instrumentation that will be used; procedure to be implemented; and the anticipated, as well as, acceptable test results. Drawings showing the relationship of the special trackwork and all significant components of the test equipment shall be included, as necessary, to describe the test set-up and procedure. The test program plan shall include the test sequencing.
 - 2. Equipment specifications, and calibration methods for all testing equipment used to perform testing and inspection shall be included in the test program plan. The plan shall indicate the calibration certificates, which will be submitted with the test reports.
 - 3. Identity and qualifications of personnel who will perform testing and inspection shall be included in the test program plan. Also include certification records for personnel who will perform nondestructive testing.
 - 4. The test plan shall include the name and location of the testing facility, qualifications of the testing facility, a description of the testing facilities, and a layout of the test equipment that will permit the efficient performance of the testing.
 - 5. The plan shall include the proposed format for reporting test data.
 - 6. The projected schedule for test procedure submittals, test executions, and test results report submittals shall be included in the test program plan.
 - 7. The test program plan shall address welding and bonded insulated joint testing separately. The test program plan shall also address qualification testing and production testing separately.
 - 8. The test program plan shall include all geometry measurements of individual components and assemble units.

9. After approval of the test program plan, obtain the approval of any proposed changes from the Engineer, in writing, prior to implementing the change.

E. Test Reports

1. Test results shall be submitted, in bound units, for each special track work unit. The test results submittal shall not be submitted until complete.
2. No special trackwork shall be shipped until all components meet all of the quality requirements herein, and the Engineer has approved test results.
3. A report of test results of each test shall be submitted which includes test name, identification of test sample, test procedure references, test equipment identification, test personnel, time and date of test, specified requirements, actual test results, nonconforming items if any, and interpretation of the results. The format for the test report shall be arranged so that the data is presented in an orderly manner.
4. Standard, computer-generated test reports may be used upon approval of the Engineer. Such reports shall be supplemented, as required, to provide all information and test and inspection results required by these Specifications.
5. Copies of calibration certificates shall be submitted with the initial test reports. If test equipment is recalibrated while work is being performed, calibration certificates shall be submitted for the recalibrated test equipment with the test reports of the first tests performed after recalibration.

- F. The Engineer shall be notified in writing not less than 7 days in advance of dates scheduled for any tests, inspections, or shop assemblies. The Engineer retains the right to witness all tests.

- G. The performance of the independent testing is entirely the responsibility of the Contractor. Any substandard conditions discovered after independent testing and inspection shall be repaired or replaced.

1.07 SPECIAL TRACKWORK IDENTIFICATION

- A. All special trackwork components and units shall be uniformly identified in all submittals and documentation. Each special trackwork unit shall be assigned a unique identification number as shown in Table 1. In addition a unique color code for all various parts shall be used.

Table 1 - Special Trackwork Identification	
Type	Identification Code
Turnouts	Interlocking and Switch Machine Number
Derails	Interlocking and Switch Machine Number

Table 1 - Special Trackwork Identification	
Type	Identification Code
Crossing Diamonds	Interlocking and the letter "D". Where multiple crossing diamonds exist within an interlocking add sequential numbering for each unit.
Restraining Rails	By track and stationing range

1.08 SPECIAL TRACKWORK WORK PLAN

- A. A. Prepare and submit a special trackwork plan with drawings for the Engineer's approval prior to manufacture. Include the following information;
 1. All design geometric measurements.
 2. Accumulative tie and/or fastener spacing of switch ties, referenced from point of switch.
 3. Closure curve offsets every 10 feet from heel of switch.
 4. Throw at each switch rod and at 10 foot intervals beyond the last switch rod to the heel of switch.
 5. Stock rail gauge line to gauge line distance at each switch rod and at 10 foot intervals beyond the last switch rod to the heel of switch.
 6. Gauge line spread, at intervals of one-half the frog number in feet, until the spread equals 5 feet.
 7. Methods of installing switch points, stock rails, and switch rods to conform to tolerances and to provide the proper clearances between rods and switch ties and fit of switch points.
 8. Include special trackwork identification codes and unique color codes to be used in turnout work plans.
- B. Submit comprehensive drainage plan and details.
- C. Install the initial turnout for inspection by the Engineer, using the approved work plan. If the initial turnout does not conform to the requirements specified herein, revise the plan in accordance with the inspection results of the initial turnout, replace or repair all non conforming items and resubmit to the Engineer for written approval prior to beginning work on subsequent turnouts.
- D. General Trackwork Arrangement Drawings
 1. All switch point assemblies shall be indicated on the general arrangement drawings, showing each component identification numbers, dimensional data for the assembly, and all control dimensions. All frogs and related special trackwork shall be indicated on the general arrangement drawings to show the relationship

of all components related to the frog, such as guide rails including all control dimensions.

2. Vertical dimensions shall be referenced to bottom of rail. Horizontal dimensions shall be referenced to designated work points. Each part shall be tagged or marked according to the assigned special trackwork identification code and shall receive a unique color code for easy identification and field sorting of components.

1.09 RESILIENT TIE AND DIRECT FIXATION SPECIAL TRACKWORK CONSTRUCTION METHOD QUALIFICATION

- A. In addition to the other requirements herein, the Contractor shall prepare and submit to the Engineer a separate construction work plan for resilient tie and direct fixation special trackwork under the requirements specified in Section 34 11 24, Direct Fixation Track. The work plan for special trackwork shall be separate from that for standard DF or resilient tie track.

1.10 WELDING

- A. Welders and welding operators shall be qualified in accordance with AWS D1.1/D1.1M, AWS B2.1/B2.1M, or other standard approved by the Engineer.
- B. Miscellaneous rolled, forged, or cast steel accessory components may be welded provided the carbon content does not exceed 0.40 percent and provided a 200 degree F minimum preheat is used for any material with a carbon content greater than 0.30 percent. Welding procedure specifications shall be qualified in accordance with AWS B2.1/D2.1M, AWS D1.1/D1.1M, or other standard acceptable to the Engineer.
- C. Welding of rail steel is not acceptable.
- D. Welding of cast iron is not acceptable.
- E. Welding of Manganese
 1. No welding repairs shall be made without the Engineer's written approval, in advance of repairs; such approvals will be made on a case by case basis.
 2. Welding repairs shall not be performed within the wheel contact area.
 3. Welding repairs shall only be performed at the manufactures facility.
 4. Welding repairs shall be made with the unit removed from the track and in a shop environment.
 5. Manganese welding repair procedure specifications shall be qualified by combinations of mechanical tests, hardness tests, nondestructive examinations, and metallographic examinations which demonstrate, to the Engineer's

satisfaction, that the repair weld metal and heat affected zone meet the requirements of the of manganese base metal.

6. The requirements for each repair weld qualification shall be made on a case by case basis, by the Engineer.
7. Manganese repaired without advance approval of the Engineer shall be rejected.

1.11 PACKAGING, LOADING, SHIPPING, AND HANDLING

- A. Handle special trackwork materials in a manner that will prevent damage during packaging, loading, and transporting. Exercise care in unloading and handling materials to prevent breaking or bending or in any way damaging the material. Materials shall be neither dropped nor thrown from cars, but shall be lifted or skidded to the ground or other surface. Do not sharply strike special trackwork.
- B. Packaging and Identifying
 1. Band all switch rails and stock rails together in one package for each turnout unit. Identify switch rails to indicate the turnout number. Identify stock rails to indicate the turnout number and whether right-hand or left-hand.
 2. Package all frogs as a single unit per turnout, and identify to indicate the turnout number.
 3. Band guard rails together; separately, and identify as to which turnout it is to accompany.
 4. Package switch plates, frog plates, guard rail plates, standard plates, gauge plates, and other small loose parts in separate units. Package the units in secure shipping boxes or kegs. Package the required number of units with each turnout, and identify as to which turnout it is to accompany. Band all switch rods within a turnout unit together in a single package, and identify as to which turnout it is to accompany.
 5. Package all rail crossing frogs as individual units, and identify to indicate both the special trackwork item and its position within the item.
 6. Package rail crossing frog plates in separate units, and identify to which crossing it is to accompany.
 7. Band rail crossing guard rails together; separately, and identify to indicate the rail crossing intended.
 8. Units, bundles, and boxes shall be clearly marked with the following information: identification of item contained, manufacturer's name, shipping date, unit designation (right or left), number of pieces, destination, and gross weight.
 9. Special trackwork shipments shall be adequately prepared and protected to preclude damage during shipment.

10. Bolts shall be delivered with a wax or petroleum based coating, or similar water resistant coating, as thread protection against rusting before installation. The remainder of the bolt surface shall have a light coating of oil.
11. Standard bonded insulated joints for shall be bundled by turnout identification number.
12. Package standard and special rail clips separately.

PART 2 – PRODUCTS

2.01 DISTRICT-FURNISHED MATERIALS

- A. Refer to Section 01 64 13, District-Furnished Materials and Equipment, of the Contract Specifications for description and quantity of District-furnished materials.

2.02 CONTRACTOR-FURNISHED MATERIALS

- A. All products, tools, materials, equipment and labor required to complete all aspects of the work shall be furnished by the Contractor, and the following.
- B. Provide explosion hardened frogs, without depressed point or ring wheel risers.
- C. Provide switch geometry as indicated on the Contract Drawings.
- D. Provide switch points and stock rails as indicated in the Contract Drawings.
- E. Switch point rollers shall be the design recommended by the manufacturer of the special trackwork. Roller installation shall not require modification of the switch point drilling shown in the Contract Drawings.
- F. Heel block assemblies shall be as indicated on the Contract Drawings. Heel blocks shall be carbon steel castings conforming to AREMA Specifications Article M3.
- G. Switch rod assemblies shall be insulated, vertical design, the Designated Matching Products specified in the Contract Drawings.
- H. Grease fittings shall conform to SAE J534. Grease fittings shall be non-corrosive material, capable of withstanding 10,000 psi maximum pressure.
- I. Adjustable Rail Braces
 1. Adjustable rail braces shall be the Designated Matching Product specified in the Contract Drawings.
 2. Castings shall conform to AREMA Specifications, Article M3.
 3. Rail brace assemblies shall comply with the fit requirements for Type A or B braces shown on the AREMA Portfolio, Plan No. 224.

4. Incorporate adjustable rail braces specified herein.
- J. Frog, Switch, and Guard Rail Tie Plates
1. Plates shall conform to the AREMA Specifications, Article M7, and ASTM A36/A36M. Plates for concrete turnout ties shall conform to the AREMA Specifications, Article M7, and ASTM A36/A36M.
 2. Plates shall be straightened cold in a press or roller machine to remove twists, waves, and kinks until they meet the required surface and line requirements. Holes in plates shall be punched or drilled through each plate perpendicular to its face, and shall be clean cut, leaving no torn or ragged edges. Drilled bolt holes shall be peened or ground to remove sharp edges.
 3. Welds on special plates shall be fillet welds conforming to AWS D1.1/D1.1M.
 4. Hook twin plates are not allowed.
- K. Bolts, nuts, and spring washers shall conform to AREMA Specifications, Articles M11 and M12.
- L. Rivets shall conform to the AREMA Specifications, Article M13.
- M. Cotter pins shall be extended prong type conforming to ASME B18.8.1.
- N. Castle nuts shall be full bearing, conforming to the AREMA Specifications, Article M11.
- O. Switch machines, switch operating rod, lock rod, detector rods, lugs, baskets, and associated hardware are specified in the Contract Specifications. Mounting of switch machines shall be interchangeable with the District's existing machines.
- P. The bolts used with castle nuts shall have the holes drilled for the cotter pins to provide a proper fit of the cotter pin and engagement of the castle nut.
- Q. Switch points, stock rail and frogs shall have an aluminum tag permanently attached to the gauge side of the rail. Tags shall identify switch length, frog number, rail section, curved or straight, right-hand or left-hand, manufacturer, fabrication date and, weight as applicable and shall clearly marked at the center of gravity for lifting.
1. Incorrect markings shall be removed.
 2. Tags if found to be incorrectly marked cannot be altered, but shall be replaced.
- R. Turnout Plate Anchorage Assemblies
1. All ties of the same length shall be identical except for the addition of conduits and as follows:
 - a. Ties supporting switch machines for all turnout types and derail layouts may be different than ties of the same length used at other locations; however,

these ties shall all be identical and work for all switch types, layouts and types of switch machines.

- b. Ties supporting auxiliary throwing device may differ from other ties of the same length only by the addition of the anchorage assemblies required for the auxiliary throwing device.
- 2. A single insulating pad shall be provided under each special plate. Pads shall be the same type and thickness and shall extend at least $\frac{1}{2}$ - inch beyond the sides and the end of the plate.
- 3. The design of special plates on concrete special trackwork ties shall also include the following:
 - a. Turnout plates shall be secured to the tie with a minimum of one embedded shoulder assembly, one on each end of the plate.
 - b. Each embedded shoulder assembly shall include a shoulder, an insulator and clip of the same type used for concrete ties.
- S. Stamped markings shall be to a nominal depth of 1/16 inch; deep stamping shall be avoided. Plate and switch rod assembly identification markings shall be clearly stamped with letters and figures not less than 1/2 inch in height, located on the top surface of the plates, plainly visible when assembled, and not subject to wear. Markings shall include rail section, left hand, right hand or equilateral, switch length, and plate number.
- T. Source Quality Control
 - 1. Production quality control testing and inspection shall be in accordance with that provided herein.
 - 2. Production Testing
 - a. During special trackwork fabrication, perform the tests and inspections specified in the AREMA Specifications and herein to ensure compliance with these Specifications.
 - b. Perform all tests and inspections in accordance with the AREMA Specifications and as specified herein. Tests shall be performed in accordance with the approved Test Program Plan and test procedures.
 - 3. Magnetic Particle Inspection
 - a. Examine each forging and weld by the dry powder method of magnetic particle inspection in accordance with ASTM E709. All forging surfaces shall be examined. Acceptance examination shall be performed at ambient shop temperature. Examination shall be performed prior to any hard surfacing.
 - b. Forgings shall be free of relevant linear indications. The forgings shall be free of defects or other injurious imperfections.

- c. Forgings and welds may be examined by the liquid penetrant method in accordance with ASTM E165/E165M in lieu of the magnetic particle examination.
4. Ultrasonic Tests
- a. Perform ultrasonic testing on all forgings and welds in accordance with ASTM E164 and the additional requirements listed below.
 - b. An ultrasonic testing procedure that is in accordance with these Specifications shall be developed. The transducer angles and scanning directions shall be fully described.
 - c. The procedure specifications shall provide for complete volumetric coverage of all forgings.
 - d. The procedure specifications shall provide for complete volumetric coverage of all welds and adjacent weld heat affected zones (HAZ). The head surface and both sides; weld and HAZ in base flanges shall be examined from at least the bottom flange surface and both web surfaces. Flash butt welds shall also have the web examined. At least three transducer angles shall be used from each surface unless otherwise approved by the Engineer.
 - e. The ultrasonic test equipment shall be capable of detecting a 3/64-inch discontinuity within the forging or weld. The sensitivity and resolution of the proposed equipment shall be demonstrated using appropriate area amplitude and distance amplitude reference blocks made of material similar to the steels being tested. All equipment shall be equipped with a distance amplitude correction feature. The equipment will be calibrated daily using an International Institute of Welding calibration block, also made of steel.
 - f. The examination shall be performed prior to any hard surfacing.
 - g. Forgings and welds will be rejected if any discontinuities of 3/64 inch or greater are discovered.
5. Liquid Penetrant Examination
- a. Liquid penetrant Examination Requirements
 - 1) Liquid penetrant examination shall be performed in accordance with ASTM E165/E165M.
 - 2) The examination shall be performed prior to any hard surfacing.
 - 3) Hard surfacing and adjacent heat affected zones shall be examined. Cavities in castings that are to be repaired shall be examined. Completed weld repairs shall also be examined.
 - 4) Finished manganese steel castings shall be examined after sheet explosive depth hardening.
 - b. Liquid Penetrant Examination Acceptance Criteria
 - 1) Cracks, seams and voids are not acceptable.

- 2) All hardsurfacing and heat affected zones shall be free of defects or other injurious imperfections.
- 3) Manganese steel castings with cracks or linear indications, sand pockets, porosity, or slag shall be rejected. Other conditions shall comply with AREMA requirements.
- c. Forgings and welds may be examined by the magnetic particle examination method in accordance with ASTM E709 in lieu of the liquid penetrant examination.

6. Hardness Tests

- a. All frog points shall be Brinell hardness tested on the head and along the side wearing surfaces in accordance with ASTM E10. Frogs shall be tested at mid-length and at the point.
- b. The hardness test results shall be 352 BHN minimum on bearing or wearing surfaces, and 321 BHN minimum elsewhere. The hardness test results on manganese steel castings shall comply with AREMA Specifications, Article M2.

7. Radiographic Examination

- a. All castings of manganese steel for frogs or crossings shall be radiographed in accordance with ASTM A781/A781M supplementary requirement S2 (ASTM E94). The film quality shall show 2 percent sensitivity (2-2T). Radiography shall be performed before explosive hardening.
- b. Castings with cracks, tears, or shrinkage shall be rejected. Casting shall be free of sand holes, sand inclusions, gas pockets or porosity, cold shuts, and inserts which would impair serviceability.
- c. All miscellaneous welds, such as those used to fabricate plates, shall be visually inspected. All miscellaneous welds shall meet the acceptance criteria of AWS D1.1/D1.1M.

- U. Furnish auxiliary throwing devices to provide a positive throw throughout the full length of the switch, on turnouts with switch points longer than 26 feet 6 inches. The auxiliary throwing device shall have successful revenue service experience under conditions equivalent to those found in the BART System. Auxiliary throwing devices shall connect to the #2, #5 and #7 switch rods, be the same type for all switches provided and shall be interchangeable.
- V. Hayes Model HBP, size 8, sliding derail and wheel Crowder is a "Designated Matching Product". The layout of the equipment with rods for power operation by a switch machine shall be as indicated in the Contract Drawings. The BART standard switch machine is the Alstom GM4000A.
- W. Provide vertical safety guard rails adjacent to aerial special trackwork at locations and as indicated in the Contract Drawings.

PART 3 – EXECUTION

3.01 FIT OF SWITCH POINTS

- A. Switch point shall fit tight against the stock rail for 85 percent of the switch point side planing. Maximum clearance at end of side planing: 1/16 inch. When closed the switch point shall be parallel with the stock rail, the first 12 inches shall fit tightly. As the point closes, the point shall come into uniform contact with the stock rail and the point end shall contact the stock rail first.

3.02 SHOP ASSEMBLY

- A. Shop-assemble all turnouts, track crossings and derails in accordance with the approved Shop Drawings.
1. All special trackwork units shall be completely assembled and inspected at manufacturers production facility prior to shipment.
 2. Where different special trackwork units share the same ties, connected ties or fasteners, they shall be assembled as a single unit.
 3. Shop assemblies shall be complete and shall include all rails, ties, fasteners, resilient ties, direct fixation fasteners, switch machines, auxiliary throwing devices and train control rods.
 4. All rail and materials used in the shop assembly shall be the same as that used for field installation for that particular special trackwork unit.
 5. All nuts, bolts and other fasteners shall be installed, completely assembled and properly tightened.
 6. All parts used for the shop assembly shall have the unique identification number and unique color code applied as required herein, applied prior to any inspections.
 7. Test, inspect and operate the equipment prior to disassembly and shipment.
 8. Repair any defective conditions found, reassemble, retest, reinspect, and operate the equipment until all requirements are met.
 9. Shop assemblies shall be performed on a reasonably smooth surface to ensure adequate inspection for conformance to all requirements herein.
 10. Shop assembly shall not include rail welding. Rail shall be adequately joined with temporary joints to ensure compliance with the quality requirements herein.
 11. All required traction power ground return bonding cables and train control bonds shall be installed.
- B. Shop assembled special trackwork shall be inspected, where applicable, for adherence to the following criteria:

1. Fit and Functionality;
 2. Alignment;
 3. Gage;
 4. Track Centers;
 5. Distances between frogs on crossovers;
 6. Heel drilling and spread;
 7. Location and drilling of holes;
 8. Length of side cut;
 9. Fit of stock rails to switch points;
 10. Fit of rails, switch points and frogs in plates and/or rail seats;
 11. Thickness at point;
 12. Fitness of rails, switch points, stockrails, frogs and other manufactured parts;
 13. Location of switch point stops;
 14. Length;
 15. Switch rod clearance;
 16. Lead;
 17. Spreads and off-sets;
 18. Frog/Guardrail Guard Face Gage;
 19. Frog/Guardrail Guard Check Gage; and
 20. Additional measurements required to ensure that the final installation will meet all applicable requirements.
- C. Except as required for resilient ties and direct fixation fasteners, no bracing will be permitted to hold components to proper gage.
- D. Contractor shall provide (or obtain through the trackwork manufacturer) templates, cranes, and other reasonable facilities and assistance required for inspection by the Engineer.

3.03 SPECIAL TRACKWORK ASSEMBLY

- A. Construct special trackwork within the specified track and turnout tolerances herein.

3.04 SWITCH MACHINES

- A. Installation shall conform to the manufacturer's installation procedures and recommendations supplemented by the Contractor's work plan specified herein.
- B. Installation shall not begin until the track is at profile grade and final surfacing, alignment, ballast compaction, and regulation are completed.

3.05 LUBRICATION

- A. Clean all slide plates and the tops of switch rods where they are under the stock rails and apply a uniformly thick coat of wet applied dry graphite lubricant over the entire sliding surface in accordance with the manufacturer's recommendations.
- B. No grease may be used on slide plates, sliding surfaces or switch rods, the tops of switch rods or underside of stock rails. If grease is found on the slide plates or switch rods, all affected surfaces shall be immediately steam cleaned and graphite lubricant reapplied.
- C. All grease fittings on switch mechanisms shall be lubricated using a product recommended by the manufacturer. Excess grease shall be removed.
- D. The responsibility for the operation and maintenance of the switch machine, switch adjustment, connecting rods and switch lubrication through the construction and testing phase remains with the Contractor.

3.06 RUNNING RAIL-TO-GROUND RESISTANCE TESTING

- A. As part of the reduction or mitigation of stray current resulting from normal operations, the Contractor shall include in the development of the final ballasted special trackwork installation specifications, provisions for conducting tests for running rail-to-ground resistance:
 - 1. After essential completion of the installation for any given special trackwork section.
 - 2. The testing shall be conducted in accordance with Construction Specifications Section 26 40 05, Rail-to-Earth Electrical Resistance Testing.

3.07 RUNNING RAIL RESISTANCE TESTING

- A. As the running rails are an essential part of the negative return system, the Contractor shall include in the development of the final ballasted special trackwork installation specification, provisions for conducting tests of running rail resistance:
 - 1. After essential completion of the installation for any given special trackwork section.

2. The tests shall be conducted to confirm that the resistance of the four running rails in parallel shall be no greater than 0.002175 ohms per 1000 feet at 30 degrees C.
- B. Contractor shall also provide a detailed narrative of the testing methods and procedures to be used in confirming the running rail-to-ground resistance to the Engineer for approval prior to conducting field testing. The detailed narrative shall at a minimum contain provisions for:
1. Quality control of the testing, including:
 - a. Testing by an independent company to be proposed by Contractor.
 - b. Number of readings to determine electrical constant (used in calculations), and
 - c. Final acceptance of test based on quality assurance verification test.
 2. Submittals, including:
 - a. Testing Group: names of agency employed for this testing.
 - b. Testing Technique: detailed written description of testing proposed,
 - c. Instrumentation: listing of instruments and their particulars including model numbers and make as appropriate,
 - d. Documentation: test data sheets showing format for record,
 - e. Test Results: data and calculations including summary tabulations of results for each test track sections for review and approval, and
 - f. Schedule: a 3-month look-ahead schedule for all planned tests.
 3. Execution, including:
 - a. Scheduling of tests in accordance with approved look-ahead schedule,
 - b. Visual inspection of the track section ready for testing, and
 - c. Electrical testing of mainline trackwork and special trackwork sections and specifying in detail the method used:
 - 1) Where the running rail insulating joints have been installed,
 - 2) Where the track section adjacent to the particular section under test has not yet been installed.
 - 3) For each method above, the applicable calculation equations to accomplish the required test shall be presented.
 - d. Definitions of acceptance criteria:
 - 1) Minimum acceptable values for the particular track type.
 - 2) Procedure to be followed when the section of the track fails the test.

- C. In lieu of the detailed narrative described above, Contractor may propose to the Engineer for approval, a separate specification section to accomplish the required testing.

END OF SECTION 34 11 23